

Appl. No. 10/666,943
Amdt. Dated Apr. 14, 2005
Reply to Office Action of Dec. 16, 2004

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1-19 (cancel)

Claim 20 (new): A hydraulic circuit including:

a hydraulic ratchet wrench having a double-action hydraulic cylinder with a piston that is displaceable in the hydraulic cylinder, a piston rod actuating said ratchet, a working stroke chamber in the hydraulic cylinder having a high-pressure chamber on one piston side and a low-pressure return stroke chamber on the other piston side with the piston rod, a hydraulic pump arrangement with a gear pump and a piston pump connected via hydraulic controls to the working stroke chamber and the return stroke chamber to drive said wrench in alternating work strokes and return strokes, wherein said circuit comprises;

a gear pump connected to said working stroke chamber by a working stroke oil line and connected by a return stroke oil line to said return stroke chamber;

said working stroke oil line connected to an oil reservoir by a first suction port;

said return stroke oil line connected to said oil reservoir by a second suction port;

an oil backflow line connected to said working stroke oil line and said oil reservoir, and a blocking valve arranged in said backflow line to selectively deliver an oil flow from said working stroke oil line;

said piston pump connected to said oil reservoir by a piston pump suction line and to said working stroke chamber by said working stroke oil line;

a pump control actuating said gear pump in one direction of rotation for delivering oil through said working stroke oil line to said working stroke chamber, and actuating said gear pump in an opposite direction for delivering oil through said return stroke oil line to said return chamber;

a working stroke flow valve arrangement in communication with said working stroke oil line to direct a flow of working oil to said work stroke chamber during said work stroke;

a return stroke flow valve arrangement in communication with said return working stroke oil line and said flowback oil line to direct a flow of oil back to said oil reservoir during said return stroke; and

said working stroke and return stroke valve arrangements operating automatically in response to flow conditions in one or more of said working stroke oil line, return stroke oil line, and backflow oil line caused by operating said gear pump in opposite directions.

Claim 21 (new): The hydraulic circuit of claim 20 including a high pressure limit safety valve connected between said working stroke oil line and said oil backflow line.

Claim 22 (new): The hydraulic circuit of claim 20 wherein said return stroke valve arrangement includes a low pressure limit safety valve connected between said return stroke oil line and said hydraulic oil backflow conduit.

Claim 23 (new): The circuit of claim 20 wherein said piston pump is activated by said pump control in the same direction with both directions of pump rotation.

Claim 24 (new): The circuit of claim 20 wherein said return stroke flow valve arrangement includes a first blocking check valve blocking flow in the direction of the first suction port installed between the first suction connection point and the working stroke chamber in the working stroke oil line.

Claim 25 (new): The circuit of claim 24 wherein said return valve arrangement includes an unblocking check valve disposed between said work stroke oil line and said oil flowback line normally blocking oil flow from said work stroke oil line to said flowback line.

Claim 26 (new): The circuit of claim 25 wherein said return stroke flow valve arrangement includes a suction check valve disposed in said work stroke oil line blocking oil flow to said oil reservoir.

Claim 27 (new): The circuit of claim 26 wherein said work stroke valve arrangement includes a first blocking check valve blocking the flow of oil in the direction of the first suction port disposed in said work stroke oil line.

Claim 28 (new): The circuit of claim 27 wherein said work stroke flow valve arrangement includes a low pressure limit valve between the first suction connection

point said working stroke oil line, whereby a flowback can be released by the low pressure limitation valve when a predetermined low pressure has been reached.

Claim 29 (new): The circuit of claim 28 wherein said work stroke valve arrangement includes a suction check valve disposed in said return stroke oil line.

Claim 30 (new): A hydraulic circuit including:

a hydraulic ratchet wrench having a double-action hydraulic cylinder, a displaceable piston located in said hydraulic cylinder, a piston rod actuating said ratchet, a working stroke chamber located in said hydraulic cylinder with a high-pressure chamber on one piston side and a low-pressure return stroke chamber on the other piston side with said piston rod, a hydraulic pump arrangement including a gear pump and a piston pump, connected via hydraulic controls to the working stroke chamber and the return stroke chamber, said gear pump and said piston pump being driven by means of a pump motor controlled by pump motor controls through its drive shaft, whereby the gear pump pumps a relatively large quantity of hydraulic oil per motor revolution and the piston pump pumps a relatively smaller amount per motor revolution, wherein said hydraulic circuit comprises:

a first gear pump connection connected to a working stroke oil line
and a working stroke chamber;

a second gear pump connection connected to a return stroke oil
line and to a return stroke chamber;

said working stroke oil line being connected to an oil tank by a first

connection point via a first suction port and a first suction check valve;

said return stroke oil line being connected at a second connection point to said oil tank via a second suction port and a second suction check valve;

said working stroke oil line having a high pressure check valve with a blocking action in the direction of said first connection point between said first connection point and said working stroke chamber;

said piston pump being connected to said oil tank via a piston pump suction line having a piston pump delivering outlet connected to said working stroke oil line;

a hydraulic oil flowback line communicating with said oil tank;

said flowback oil line connected via a low pressure limit valve to said working stroke oil line whereby a flowback is delivered by the low pressure limit valve when a predetermined low pressure has been reached;

said flowback oil line being connected via an unblocking check valve controlled as a function of pressure in said return stroke oil line to said working stroke oil line, said unblocking check valve normally blocking flow to said flowback line; and

a pump motor actuated for a working stroke in one direction of rotation to pump oil through said delivery outlet of said gear pump, said pump motor actuated for a return stroke to rotate in the opposite direction, to pump oil through said suction inlet of said gear pump, and said radial piston pump pumping oil in the same direction with both directions of rotation.

Claim 31 (new): The hydraulic circuit of claim 30 including a high pressure limit safety valve connected between said working stroke oil line and said oil flowback line.

Claim 32 (new): The hydraulic circuit of claim 31 including a low pressure limit safety valve connected between said return stroke oil line and said oil flowback line.

Claim 33 (new): The hydraulic circuit of claim 32 where said gear pump is able to produce a maximum conveying pressure of approximately 100 bar and at least one of said low pressure limit valve and said low pressure limit safety valve is adjusted to approximately 70 bar.

Claim 34 (new): The hydraulic circuit of claim 33 where said radial piston pump produces a maximum conveying pressure of approximately 700 bar and said high pressure limit safety valve is adjusted within a range between said low pressure limit valve and approximately 700 bar.

Claim 35 (new): The hydraulic circuit of claim 34 where the maximum working stroke chamber volume is greater than the maximum return stroke chamber volume and wherein the ratio is approximately 3:1.

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Claim 36 (new): The hydraulic circuit claim 35 where said pump motor controls are actuated manually or automatically and said wrenching process is controlled by one of manually, as a function of time as a function of working pressure and as a function of torque.